NHDOT SPR2 PROGRAM
RESEARCH PROGRESS REPORT

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a progress report at least every three months during the project duration. Reports are due the 5th of the month following the end of the quarter. Please provide a project update even if no work was done during this reporting period.

Project # 26962G		**Report Period** Year: 2016 ☐Q1 (Jan-Mar) ☐Q2 (Apr-Jun) XQ3 (Jul-Sep) ☐Q4 (Oct-Dec)
Project Title: The Living Bridge: A Benchmark for Bridge Monitoring The Living Bridge: Tidal Turbine Deployment System		
Project Investigator: Erin S. Bell Co-Project Investigators: Martin Wosnik, Kenneth Baldwin **Phone: (603)862-3850** **E-mail: erin.bell@unh.edu**		
Research Start Date: sample July 1, 2016	**Research End Date:** September 30, 2018	**Project schedule status:** ☐ On schedule ☐ Ahead of schedule ☐ Behind schedule

Brief Project Description:

This project is a collaborative project between the civil and environmental engineering, mechanical and ocean engineering programs at UNH, the NHDOT and several industrial partners to install an array of structural health monitoring, environmental and estuarine sensors on the Memorial Bridge in Portsmouth, New Hampshire that will be powered by a tidal turbine attached to the bridge pier. The funding for the Tidal Turbine Deployment System is leveraged with funding provided by the National Science Foundation's Partnerships for Innovation Program, The Living Bridge: The Future of Smart, Sustainable User-Centered Transportation Infrastructure.

Progress this Quarter (include meetings, installations, equipment purchases, significant progress, etc.):

Benchmark for Bridge Monitoring:
The final instrumentation plan for the structural health monitoring was discussed at the June 28th 2016 technical advisory group meeting. On July 1, 2016, Professor Bell discussed the conduit installation with Jim Casey of Yates Electric. Mr. Casey informed Professor Bell that the conduit would be 1-2 week lead time and that his crew would require 2 weeks for installation.

The NHDOT requested the removal of 10 strain rosettes and the additional of two uniaxial strain gauges. UNH updated the instrumentation plan to reflect the requested changes and submitted a revised plan to the NHDOT. The plan was approved on July 18, 2016. Following this approval, UNH scheduled the instrumentation installation with Yates Electric, Bridge Diagnostic, INC and Gene Popien for September 19th.

On August 24th, 2016, Professor Bell received a message from Yates Electric that there was an issue with the conduit installation cost and schedule. Through a follow-up discussion, Professor Bell was informed by Jim Casey of Yates Electric that the fiberglass conduit would be an 8 week lead time and come at an increase cost. After consulting with NHDOT, Professor Bell agreed to this cost increase and schedule delay. The conduit was ordered and the contract was signed with Yates Electric. The new installation date is November 1, 2016. This date is confirmed with both Bridge Diagnostics and NHDOT as well.

The structural model of the Memorial Bridge is under development at UNH in both Lusas® and SAP2000®.

Tidal Turbine Deployment System
The design of the turbine deployment system consists of vertical guide posts (VGPs) and a turbine deployment platform (TDP). The structural design of the both the VGPs and the TDP was submitted to Duncan Mellor of Tighe and Bond for peer-review on June 2016. The comments and suggestions were integrated in the structural design and the revised design

document was submitted to the NHDOT for review and approval. Three quotes were solicited for the fabrication and installation of the VGPs. These quotes were shared with Bob Landry for comment. Upon approval of the design and the contractor selection, UNH contracted with Pepperell Cove Marine of Portsmouth, NH, for the fabrication and installation of the VGPs. UNH is awaiting the shop drawings from the steel fabricator for submission to the NHDOT for approval. The installation is planned for early November.

The TDP design was completed including the estuarine instrument mounts. Given the 7-8 week lead time for the pontoons, the pontoons for the TDP were ordered on September 16th inform ISCO Industries INC. The drawings for the steel TDP frame were sent to three contractors for estimates in early September. The selection of the fabricator and installer will be made by the end of October.

UNH met with the NHDOT, Army Corps of Engineers and the US Coast Guard in March 2016 to discuss the permit required for the installation of the tidal turbine deployment system. The result of this meeting was that a permit was not required for the installation as both the vertical guide posts and the platform were considered part of the bridge. The Army Corps of Engineers created a file number, NAE 2016-00633, where the risk management and design documents could be filed. UNH will file these documents within the next few weeks.

The Living Bridge
On August 23rd, the National Science Foundation interviewed the research team from UNH along with Bob Landry for a video profile of the Living Bridge project for Science Nation. This video should be release in early November.

The project was highlighted on September 16 and 17, 2016 at UNH Ocean Discovery Day.

Items needed from NHDOT (i.e., Concurrence, Sub-contract, Assignments, Samples, Testing, etc…):

UNH is awaiting a copy of the structural design calculation submission for the Memorial Bridge. Bob Landry is schedule to provide these calculations on October 5, 2016.

UNH also requires all available information related to the cathodic protection system at the Memorial Bridge to ensure that the installation of the VGPs will not interfere with the cathodic protection system, as well as the cathodic protection system will not interfere with the corrosion protection on the VGPs.

UNH will need a letter of permission to be submitted by the NHDOT to the US Coast Guard Bridge Division so that the US Coast Guard can issue a notice to mariners and permission for construction.

Anticipated research next 3 months:

Benchmark for Bridge Monitoring:
The installation of the structural health and environmental instrumentation and networking of the sensors for remote access is scheduled for completion in November 2016.

The completion of a global model of the Memorial Bridge in SAP2000® and Lusas® as well as local model of selected gusset-less connections at the Memorial Bridge is scheduled for completion in December 2016.

Tidal Turbine Deployment System
A contract for the fabrication and installation of the turbine deployment platform (TDP) frame should be in place by the end of the October to allow for delivery of the TDP by December 21016.

The installation of the vertical guide posts at the Memorial Bridge is planned for November 2016.

The deployment of the turbine deployment platform with estuarine sensors at the Memorial Bridge is planned for a short duration in December 2016 provided the construction of the VGPs is not delayed.

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Circumstances affecting project: Describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope, and budget, along with recommended solutions to those problems.

As described in the "Progress this Quarter" section of this report, the schedule delay and increased cost related to the electrical conduit negatively impact this project.

Tasks (from Work Plan)	Planned % Complete	Actual % Complete
Living Bridge: Creating a Benchmark for Bridge Monitoring		
Project Coordination	**100**	**100**
Structural Model Creation	**50**	**50**
Design the instrumentation Plan	**100**	**100**
Sensor Deployment	**100**	**0**
Data Collection and Model Calibration	**0**	**0**
Incorporation of collected data and model into NHDOT protocols	**0**	**0**
Final Report and Adoption Recommendation	**0**	**0**
Turbine Deployment Structure		
Deployment Structure Design	**80**	**80**
Project Permitting	**100**	**80**
Installation of vertical guide posts	**100**	**0**
Procurement of the turbine deployment platform	**0**	**0**
Site Installation	**0**	**0**
Electrical Connection	**0**	**0**
Final Report and Poster	**0**	**0**